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NASA Tests Design Concept for a New Pumpkin-Shaped Balloon

High flying balloons carrying science experiments for up to 100 days are closer to becoming reality early in the next century thanks to advanced materials and a new design by researchers led by the NASA Goddard Space Flight Center's Wallops Flight Facility, Wallops Island, VA.

A test flight was successfully conducted recently from Ft. Sumner, N.M. of a pumpkin-shaped balloon half the size of a football field and approximately one-tenth the volume of what NASA calls its Ultra Long Duration Balloon (ULDB).

When fully inflated, the two million cubic foot prototype was 105 feet (32 meters) tall with a diameter of 174 feet (53 meters) and achieved the expected altitude of 86,000 feet (26 kilometers).

The full-scale ULDB will be more than twice the size of the prototype. Even more impressive than its size is the new balloon's staying power. The ULDB will stay aloft at altitudes of up to 115,000 feet (35 kilometers) for as long as 100 days with more than a ton of scientific instruments. Scientific balloons currently in use typically fly for up to three weeks.

"Through enhanced computer technology, high-tech materials and advanced designs, we hope to revolutionize the size, shape, durability and stamina of the present long duration scientific balloon and open a new frontier for high-altitude research," said Harvey Needleman, Chief of the Balloon Program Office at Wallops. "The recent test launch, Oct. 23, 1999, provided valuable information in the development phase of the ULDB." NASA plans to fly the Ultra Long Duration Balloon in 2001.

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Although balloons have been flying for more than 200 years and scientists have long used them for a variety of research missions, the length of time balloons can stay aloft has always constrained their efforts. NASA presently flies conventional and long duration scientific balloons gathering data from the uppermost region of Earth's atmosphere. A conventional balloon flight will last from one to two days while a long duration balloon flight will last up to three weeks. Researchers today are focusing on obtaining even more data during longer flights using an ultra-long duration balloon.

"Flights of a significant duration require balloons to fly in the most extreme environmental conditions over oceans, deserts and even the polar ice cap. NASA's new ULDB will be designed for longer flights above 99 percent of the Earth's atmosphere. The material used to make them must be strong and adaptable," said Steve Smith, NASA's ULDB project manager. An article on the ULDB, co-authored by Smith and James A. Cutts, of the Jet Propulsion Laboratory in Pasadena, Calif., is featured in the November issue of "Scientific American".

According to Smith, the ULDB will be made from a new material composite and will be a pumpkin-shaped structure rather than the spherical design of most other super pressure balloons. The new material consists of three bonded layers, a polyester fabric provides strength, a polyester film prevents helium molecules from leaking out and a polyethylene film contains the gas and provides added toughness. The material has increased strength and the ability to withstand damage by ultraviolet rays, while the pumpkin shape reduces material strength requirements and stress on the balloon.

Today's scientific balloons are usually one of two types, zero pressure or super pressure. The zero pressure balloon leaves the ground when it is filled with enough helium to offset its total weight, including the experiment package. Once the desired altitude is reached, ducts at the base of the balloon vent excess gas to maintain stability and prevent rupturing of the thin polyethylene balloon material. As the sun heats the balloon during daylight hours, gas is vented. As nighttime approaches the gas cools and the volume of the balloon contracts and it begins to descend. To maintain altitude, the balloon system must drop ballast. The duration of the flight is determined by the amount of ballast carried. Most zero pressure flights last only a few days.

Like the zero pressure balloon, the super pressure balloon will be partially inflated when it leaves the ground. Unlike the zero pressure balloon, which has venting ducts in the bottom, the super pressure ULDB will be inflated and then completely sealed. This is possible because the ULDB will be made of a highly durable fabric that can withstand high internal pressures caused by solar heating and will not react to atmospheric influences allowing the ULDB to maintain lift, size and shape. Maintaining helium at a constant volume and density also will make the ULDB an extremely stable platform for scientific research.

For more information on NASA's Scientific Balloon Program visit NASA Wallops Flight Facility homepage at: http://www.wff.nasa.gov or the Balloon Program website at: http://www.wff.nasa.gov/pages/scientificballoons.html

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